



ON THE

DRESSING OF STUMPS.

OLD METHOD—LISTER'S ANTISEPTIC PLAN—THE BORDEAUX
TREATMENT OF STUMPS, BUROW'S PLAN, MODIFIED
BY THE AUTHOR—COMPARATIVE STATISTICS.

BY LOUIS BAUER, M. D., M. R. C. S., ENG., ETC.

REPRINTED FROM THE ST. LOUIS CLINICAL RECORD, NOV. AND DEC., 1877.

ON THE DRESSING OF STUMPS.

BY LOUIS BAUER, M. D., M. R. C. S., ENG., ETC.

If a surgeon to-day should claim the healing of a wound or of a fracture as the merit of *his* work, he would place himself in the alternative attitude of an ignoramus or pretender.

Experiments upon the lower animals and microscopic investigation have most thoroughly dispelled such a delusion. Nature has amply provided for the repair of such injuries, healing taking place by first intention or by suppuration; by a process both spontaneous and invariable.

The perfection of surgical art is reached when the injured parts are placed in the most favorable conditions for repair. The latter itself needs hardly any assistance. Whilst the simplest means subserve the object, artifice is more likely to disturb the spontaneous action and cause mischief.

In studying the elementary changes in structures concerned in an *incised wound*, a steadily progressive metamorphosis in the structural elements is noticeable terminating eventually with cicatrization.

The details of that process are both highly interesting and instructive.

The first changes exhibited by the wounded surface is thrombosis of the superficial capillaries, whilst the deeper ones considerably dilate. Thus a larger volume

the transfusion of serum and the migration of white blood corpuscles into their parenchyma, rendering it succulent and soft. The corpuscles of the connective tissue, originally so delicate and diversified in form, exhibit themselves under the microscope as large and spheroidal cells with proliferated nuclei. And next begins the division and multiplication of cells *ad infinitum*, in which the cysto-blasts largely participate. By their automatic movements, the cells continuously change their places, glide up and downwards, from one side of the wound to the other, until, at last, they gather in groups, press together, elongate (fibro-plastic cells) and form scar tissue. Before, however, this stage is reached, numerous new capillaries have already sprung up combining with others of their own and the opposite side, forming anastomoses and loops, passing through one another in the center of the wound and thus perfect the *primitive connective tissue* by which the two sides of the wound are united and the continuity re-established.

It will thus be seen, that the wound unites by a *newly-formed tissue* and not by immediate agglutination. Furthermore, that the new tissue passes through various

soft to a firmer and dryer condition, that the first intention, as a rule, will be effected if the state of the wound is favorable and the repair not disturbed by officious interference.

As a matter of course, those delicate phases elicited by experiment and observed under the microscope, are not revealed to the surgeon when they take place in amputation wounds. Nevertheless, some conspicuous changes in the flaps indicate what is going on in their substance. Thus, between the twelfth and twenty-fourth hours after the operation, the flaps swell, assume a semi-globular shape, become succulent, elastic, red and tender, and exhibit a higher than the normal temperature. All these symptoms of active repair again gradually subside, but the swelling, in a measure, will continue beyond cicatrization, thus demonstrating that a new structure has been superadded and is being interposed between the flaps.

Anxious to see the flaps united by first intention, the surgeon naturally asks himself, what is best to be done to bring about so desirable a result and to prevent suppuration with its noxious consequences?

In carefully considering the details of the reparative process in incised wounds, he can not be at a loss as to what he ought not to do, viz :

He must not attempt interfering in the spontaneous action by which repair is effected. Masterly inactivity is obviously the best axiom in the premises. Surgery possesses no agents to accelerate that process ; let the surgeon take heed not to disturb or to delay it. In taking surgical pathology as a guide, the duty of the attendant is discharged when he has securely ligated the bleeding vessels, completely arrested all sanguinolent oozing, carefully cleansed the wounded surfaces, brought the flaps together, sutured the margin of the wound with a view to impending swelling, placed the stump upon a softly-elastic bed of cot-

tompress and kept the air off by a piece of oiled silk.

The surgeons of the past have not contented themselves with so simple a treatment, but they were excusable, since surgical pathology was to them a sealed book. But when the errors of our ancestors are perpetuated by surgeons of our time, by professors of, and authors on surgery, it is indeed time to remind them of the fundamental principles ruling modern surgery.

The customary dressing of stumps is in irrepressible conflict with those principles, and invites criticism.

The adhesive strips which are drawn rectangularly across the wound are not only superfluous but irrational and objectionable. If they are applied for the purpose of keeping the flaps in apposition, they may render such service in the first few hours after the amputation. At a later period, when the swelling of the flaps has set in, they are no more needed, since the swelling itself effects the approximation of the surfaces, and being softened, the surfaces mold themselves to an almost complete closure of the wound. The adhesive plaster then becomes injurious, by resisting the swelling so needful to the process of repair. But there is another objection to the adhesive strips : they seal up the margin of the wound, and prevent the escape of secreted fluids from its precinct, and so, eventually, may give rise to pyæmic and septic infection.

Besides, Burow contends, and with good reason, that the pressure of adhesive strips prevents the formation of large and firm thrombi in the vessels and favors their decay and embolism.

Equally objectionable is the bandage, by which the stump is surrounded. If loosely applied, it is worthless, if firmly encircling the stump, it confines and compresses it, with all the detrimental consequences referred to.

Some surgeons imagine that adhesive

cratis are indispensable means for the protection of the flaps and also as a safeguard against hemorrhage. Such a protection is of very questionable service which indirectly interferes with repair; and as a safeguard against bleeding it is absolutely nugatory, as every experienced surgeon must attest.

My observations on this mode of dressing, more particularly during the civil war, both on the battle-field and in the military hospitals, have fully convinced me of its dangers and of the disasters it brings to the patient.

At Franklin's farm, in Maryland, where a hospital station had been established, after the battle of Antietam, and to which a large number of seriously wounded and amputated soldiers of both armies had been removed, I found ample opportunity to satisfy my mind of the unsuitableness of such a dressing.

I arrived at that hospital three days after the battle and took charge of a large number of patients. All of them complained of the intolerable pressure of the bandage, all suffered the tortures of Sisyphus. On removing the dressing from their stumps, I found the latter so terribly constricted, that the flaps appeared cyanotic. The various turns of the bandage, as well as the adhesive strips, had made deep gullies, between which the flesh protruded. As soon as the dressing was taken off the stumps at once distended, the flaps parted, the sutures having cut through, and the pent-up matter escaped in great quantity. But very few of the unfortunate men were in a condition to recovery.

Similar scenes I observed at Fortress Monroe and elsewhere. Nor do I intend to disparage American surgery, for I have noticed the same dressing in Europe, and from the remonstrance of Prof. Burow, made in 1866, I apprehend that the same mode of dressing was resorted to in the Austro-Prussian war of that time.

As early as 1859, Prof. Burow, of the

University of Königsberg, Prussia, in an article of great scientific merit and force of argument, exposed the customary dressing of stumps as diametrically opposite to the existing indications. His voice was one of the few who first protested and suggested improvements. His views were so plausible and conclusive, that I not only adopted them in my own practice, but I also translated his article for the *Medical Gazette*, of New York, so as to extend its benefits to the profession of our country.

With his modification of dressing, Burow had, in a given time, terminating in 1859, performed sixty-two amputations, viz:

Upon the Forearm.....	15
“ “ Humerus	20
“ “ Metatarsus	1
“ “ Leg.....	11
“ “ Thigh	15
	—
	62

Of this number he lost *but three cases* from amputation, (of the thigh), that is less than five per cent. These extraordinary statistical returns can not be ascribed to leniency of the cases themselves, which were mostly of a very aggravated traumatic character; the poorer classes had furnished by far the greater contingent; most of them had to be transported from the country in common wagons over rough roads, and had suffered loss of blood and hardships of every kind. Moreover, they were received and treated at a public hospital of Königsberg not particularly renowned for its excellence. In fine, Burow expressly disclaims superior skill in the operations; since many of them were performed by advanced students.

When, therefore, the conditions of Burow's patients were about even with those of other surgeons and other public hospitals, to what circumstance have we to ascribe his obviously better results? Burow, himself, claims them as the fruit of improved stump dressing.

Next, there is Lister's and Azani's modes. The former has been dignified as the *antiseptic*, the latter as the *Bordeaux treat-*

ment of stumps. In some points the two methods are the same. Both insert drainage tubes reaching to the bottom of the wound; both keep the flaps in apposition by the so-called deep suture; Lister by carbolized catgut, Azam by silver wire; both unite the margins of the wound, the former by either carbolized silk or silver wire and the twisted suture, the latter by delicate hair-lip needles. But in the rest of the dressing they widely differ. Professor Azam contents himself with dropping loose cotton wool upon the stump, whilst Prof. Lister makes extensive use of carbolic acid, and other materials.

Leaving aside, for the present, the specific differences of their respective dressings, I shall first consider the surgical value of that part upon which they coincide.

Prof. Gosselin, of Paris, in his recent lectures on "The Dressing of Wounds," raises claim of priority in favor of Azam and his Bordeaux method. But since this method is made up of the suggestions of others, viz: the use of drainage by Fochier and Broca; the deep suture by Langier, and the figure of 8 suture, so long known that its originator has been forgotten, the merits of Azam should not be urged. Mr. Lister is certainly as much entitled to the use of common surgical property, and to the same appropriation of the labor of others, provided he does not claim them as his own.

We are informed by Gosselin that the Bordeaux method has the effect that: "the edges of the wounds cicatrize by first intention and the deep parts reunite," and are thus free from grave sequelæ.

"All this is not mere illusion. The twenty-six cases gathered and published by Dr. Azam are proofs of it"!!!

If the testimony of Gosselin stood in need of any additional strength it might be found in the fact, that Prof. Lister has likewise adopted the very same method. Thus far the indorsement of the Bordeaux method leaves nothing to be wished for. But it would appear as if Gosselin does not speak

from his own experience when he takes his proofs from Azam's cases. Yet, among them deaths have happened, as Gosselin admits, but we don't know how many nor in what arithmetical proportion. Further, he expresses his regret that the Bordeaux method has not been so favorably received and adopted by the profession in France, and this seems a most ominous admission.

Irrespective, however, to those outside circumstances, I have no hesitation in taking issue with Prof. Gosselin. Firstly, on the insufficiency of the statistics adduced, but still more, secondly, that the method of Dr. Azam is positively objectionable.

Twenty-six cases are scarcely a sufficient statistical basis for judging of the usefulness of a surgical method for which so much is claimed. Besides, deductions by death are yet to be made from this number.

The chief objection to the method is in point of its relation to the wound itself. Every surgeon is aware that in dressing an amputation wound, the approximation of the flaps, however perfect, leaves a coniform space at the base of the wound which Gosselin is pleased to term bone-chamber. At this place air remains which, but too often, excites limited suppuration. To place drainage tubes in the wound so as to carry off the matter from the bone-chamber seems to be a most commendable suggestion. The drain tube is, however, a foreign body which, mechanically, and possibly chemically, must irritate the wound, rather increase suppuration and delay cicatrization. If, therefore, the healing by first intention seems to be secured, the drain tube will effectually prevent it. The trouble of a limited quantity of matter within the amputation wound is a mere trifle when compared with the effects of a drain tube. For if the wound is not very tightly held together, the matter will work itself out to the nearest place with but passing inconvenience; eventually a suture should be removed to facilitate its escape.

The deep sutures of both Azam and Lis-

ter are, to say the very least, superfluous, but more likely injurious. I have already, at another place, shown that the flaps soften and swell and by this means approximate one another without any interference whatsoever. In transfixing the flaps by one or several sutures, as both Azam and Lister do, they restrain the swelling and interfere prejudicially with the repair of the wound. The catgut of Lister would seem less injurious than the silver wire of Azam, since the former, in about three days, is dissolved and the restraint removed.

I have now to approach Lister's anti-septic treatment, as next in order, and feel somewhat diffident in placing my views on record, inasmuch as Lister's plan has been considerably received by surgeons and more or less adopted in practice. Enthusiasm and fashion in surgery are, however, most dangerous pretenders to scientific credit and should be met by cool reasoning and careful, unbiased investigation. It is very likely that Lister's anti-septic method has been treated unfairly by both its friends and opponents. The one in expecting too much and the other in refusing to acknowledge its actual merits. Lister's anti-septic dressing is set forth as a preventive of sepsis, but not as a curative, and therein lies the misconception with many.

Science has conclusively proven that the atmospheric air contains impurities, mechanical and organic substances which, when precipitated upon wounded surfaces will give rise to decomposition of matter, deter the healing process and create danger to life. Whether these elements are identical with the bacteriæ or vegetable spores, or with mere dust, is of little concern to us in the discussion of the subject. For all practical purposes it is quite sufficient to know the fact. For years Prof. Lister has endeavored to find out appropriate means to prevent those injurious effects of the air, by either *filtration*, *exclusion* or *destruction* of the organic impurities. And with a diligence and assiduity he has pursued his

course of study, for which the surgical profession owes him due acknowledgement. If Mr. Lister had achieved nothing else than to have left the beaten track of surgical usage and demonstrated the absolute necessity of change and rational reform, his merits would be indisputable. This has, however, no weight in the estimation of his new plan, which must stand or fall by its own therapeutical virtue or demerit.

The fact that subcutaneous wounds, as a rule, heal by first intention, was rather suggestive in the treatment of open wounds, and their conversion into the former was attempted by collodium dressing. Lister has tried to improve that plan by superadding his anti-septic agents. Unfortunately his method is so circumstantial and so complicated that few surgeons will find themselves in the enviable position of being able to follow it in all its details. Practitioners in small cities and in the country, and military surgeons in the field, are debarred from using Lister's plan, being deprived of both schooled assistants and the multifarious agents which its author deems indispensable. That the therapeutical effects of the anti-septic method are notably better than the old stump dressing may be admitted without reservation, and yet it may fail in securing followers and in becoming popular with the surgical profession.

From Dr. A. C. Girard's Report to the Surgeon-General U. S. A., on Antiseptic Treatment of Wounds, we derive the following information as to the latest improvements in Lister's antiseptic method:

1. Carbolized Solution (Acid. carbol. cryst. 5, aq. 100) is used to clean the neighborhood of wounds before operation, to disinfect the hands of surgeons and assistants, and instruments, to wash out septic wounds and clear drainage tubes.

2. Carbolized water, a $2\frac{1}{2}$ per cent. solution of crystalized carbolic acid in water. It is used in the spray and to wet the "gauze."

3. Carbolized Oil. (Acid. carbol. cryst. 5, ol. oliv. 100), to oil catheters or other instruments, or fingers when about to be

introduced into some of the cavities. It is also employed when a constant direct contact of the antiseptic with the wound is necessary, as in caries—or where the gauze dressing cannot be applied, as in abscess of the rectum.

4. Solution of Chloride of Zinc (8 per cent.) 1 part of liq. zinc. chlor. mixed with three parts of water. Where wounds have been exposed unprotected to the access of atmospheric air, or where, from mistake in dressing, aseptic wounds have become septic, they are swabbed out with this solution. It is more effective than carbolic solution, but too powerful for permanent use in the dressings.

5. The Spray. In order to prevent the entrance of living germs, during an operation or dressing, a spray of "carbolyzed water" is directed on the wound. The best instrument for this purpose is "Lister's spray," a steam atomizer which throws a large cone of finely divided spray. It is almost indispensable in long operations and where a considerable space of tissue is exposed. In its absence it may be replaced by the ordinary steam atomizer, of which two ought to be at hand, as they are soon exhausted. Their suction tube is unnecessary and a glass tube, drawn to a fine point, and bent at an acute angle, to throw the steam against wounds without necessity of tipping the instrument, may take its place. In the absence of these, or for short dressings, Richardson's spray apparatus may be used. It has, however, serious defects; it gives out frequently without apparent cause, is very fatiguing, and wets the wound too much, as the spray is not as finely divided as that of the steam atomizer.

6. The Protective is oiled silk, coated with copal varnish, to render it impermeable, and then covered with a thin layer of one part dextrine, two parts starch, and sixteen parts "carbolyzed solution," to facilitate adhesion of the disinfecting fluids into which it is dipped before being applied to the wound. The purpose of the "protective" is to prevent the irritating effect of the contact of the antiseptic with the wound. It is placed immediately over this, overlapping it but little.

7. The Antiseptic Gauze, a peculiar unstarched cotton gauze, selected by Mr. Lister on account of the facility with which secretions penetrate its meshes. It is prepared with antiseptics, and thus, after absorbing the wound fluids, it prevents their

decomposition. Pieces of cotton gauze, six yards in length and one yard in width, are to be placed in a zinc trough and heated in the water-bath for several hours, after which they are spread out and a hot mixture of one part cryst. carbolic acid, five common resin and seven paraffine is poured over them by means of a syringe. They are then returned to the trough and submitted to pressure for some hours, to cause an even distribution of the fluids. The resin is to hold the carbolic acid more firmly, and prevent it from being washed out or evaporated too quickly. The paraffine diminishes adhesion of the dressing. This gauze is prepared in factories in Germany, the best known being the "International" factory, at Schaffhausen, Switzerland. Its great cost (20 cents a yard in the factory) is a considerable drawback. I have, therefore, tried to replace it by cheaper material, and to prepare it myself, and have successfully used old mosquito netting for this purpose. As this is really the only part of Lister's dressings for which the Army Supply Table does not furnish the materials, it may be of interest to learn how it is done. Old mosquito bars, which have become useless for their legitimate purpose, are steeped, or, perhaps better, boiled in lye, to remove all dirt and render them more hygroscopic. They are then immersed in the hot resin mixture, which may be heated in a tin bucket on the stove. To remove the surplus liquid they are passed through a clothes-wringer, allowed to cool, stretched into shape, and put away in a closed vessel or wrapped up in oiled muslin. The clothes-wringer is easily cleaned with boiling water and a cloth. I have used this antiseptic netting with the same results as the imported gauze.

The gauze is used wet with carbolyzed water in immediate contact with the "protective," folded in about six thicknesses and overlapping the "protective" several inches. The remainder of the gauze is applied dry. Lister considers eight layers, *largely overlapping* the wound, sufficient. Between the seventh and eighth layers he inserts the "McIntosh."

8. The McIntosh, common rubber cloth, is used to keep the secretions of the wound from finding their way immediately to the surface, and to compel them to permeate the whole dressing, thus being constantly in contact with the carbolic acid. It is cut an inch smaller than the gauze, that the

ON THE DRESSING OF STUMPS.

secretions, when about to appear externally, may be discovered while yet lying in antiseptic material. The "McIntosh" need not be renewed with the dressing, but may be washed off with carbolized water and used again.

9. Catgut is the *sine qua non* of Lister's dressing for ligatures and deep sutures. In a few days it is absorbed and the wounds close over it without danger of its acting as an irritant or permitting hæmorrhage. In order to prevent its becoming soft, spongy and slippery, it has to go through a process by which it is rendered tough, flexible and able to resist the action of the wound secretions for a sufficient length of time. It is first shaken up in a carbolized emulsion of one part cryst. carbolic acid (dissolved by addition of ten per cent. water), and five parts olive oil. It should then be no more disturbed but set aside in a cool place. The catgut should be kept separate from the watery part of the emulsion. This is most conveniently done by placing a sufficient number of pebbles into the vessel containing the emulsion to support a small disk of glass out of reach of the water, on which the coils of catgut are laid. It takes at least two months before it acquires the necessary qualities. The catgut is used in different sizes, from the thickness of a horse-hair to that of twine.

15. Salicylic Cotton. Mr. Lister has of late used this to bolster up and fill inequalities of the surface. The salicylic acid not being volatile, and cotton easily impregnated by it, it forms a useful supplement to the gauze. It is prepared by first removing the fatty matter of the cotton, by boiling it in lye or other alkaline liquid. Thus the cotton becomes hygroscopic, which quality may easily be tested by throwing a small ball on water. In its natural state it will not sink—if prepared it will go to the bottom of the vessel in a very short time. The proportions are about eight ounces of the acid, eight ounces alcohol, and two gallons of water. The addition of about twenty per cent. of glycerine is said to prevent the disagreeable dusting of the acid.

11. Sponges. All sponges used in connection with Lister's dressing, in the cleaning of wounds and absorption of wound secretions, should be prepared in the following manner: After being beaten, cleaned and washed out in lukewarm distilled water, they are immersed in the "carbolized solution," and kept there until

needed. After use they are washed out in the solution and replaced in the vessel. In this manner they can be used over again as long as they last. In addition to the usual small dressing sponges, some larger ones are to be kept on hand. They are applied to wounds the first day after the operation to absorb the more copious secretion caused by the spray.

12. Drainage-Tubes are small flexible rubber tubes, of the size of a small quill to that of a little finger, with numerous openings on the sides, each of half the diameter of the tube. Their use is to facilitate the egress of wound secretions without interfering with union. One or more are introduced, according to the size and number of angles of the wound, reaching to the bone. They are secured to the skin by a thread drawn through their extremity and fastened by a strip of isinglass or a small safety-pin. They must be cut on a level with the skin, as otherwise the pressure of the dressings will obstruct their lumen. In places where the slippery rubber tube is not easily retained, as in the anus, some lint dipped in carbolized oil might take its place. Of late Mr. Lister adds to the rubber tube several threads of catgut. The tube is removed in a few days, the catgut assisting in the drainage as long as it is necessary and is then absorbed, the outside parts falling off.

13. Antiseptic Silk. The catgut is only used in ligatures and deep sutures. For superficial sutures it does not retain its firmness long enough and silk is preferred in its stead. This is rendered antiseptic by being steeped for an hour in a hot mixture of beeswax ten, cryst. carbolic acid one, and then drawn through a cloth to remove the surplus wax. It is then preserved in a closed vial. In this manner it combines the advantages of the wire with the suppleness of the silk. Septic germs can not penetrate in the interstices of the fibre, and the wax, besides increasing the hold of the knot, retains a sufficient amount of the antiseptic to destroy any germs which might enter the suture.

As to the practical utility of Lister's method, we have, among other documentary evidence, the testimony of Dr. A. W. Schulze, a military staff surgeon of the Prussian army who was sent to Edinburgh by his government for the purpose of investigating the practice of Lister and

ascertain its results from the evidence obtained.

Dr. Schulze tells us in his paper* that from the experiments he had seen instituted by Prof. von Bardeleben at the Charité Hospital, of Berlin, with Lister's method, he had formed no particularly favorable opinion of it. At any rate "the results remained far behind those on which Lister prided himself: First intention of wounds was not oftener obtained; erysipelas occurred not less frequently than with the former dressing, and in spite of the liberal use of carbolic acid, bad conditions of wounds happened and cicatrization was rather tedious if not clearly delayed by that drug."

Consequently, as an archskeptical, and not as an enthusiast, Dr. Schulze went at his task.

After a sojourn of four weeks at Edinburgh, Dr. Schulze proceeded to Glasgow, Belfast, Dublin, Liverpool, Manchester, Birmingham, and lastly to London, pursuing but the one object of inquiry.

The paper of Dr. Schulze is full of valuable information, collected at the various places he successively visited pursuing the study of the modifications of the antiseptic method. But the limited space allotted to this article does not permit of reproducing the details on this occasion.

Although Dr. Schulze regrets that his brief stay at Edinburgh afforded him but a limited opportunity for observation, he evidently made excellent use of his time.

To the question, what results are obtained by Lister's method? Dr. Schulze gives the following answer: "During my short stay at Edinburgh, no death; Lister's service consists of over fifty beds, which are mostly filled with serious surgical cases. About the mortuary statistics *no records are as yet kept to facilitate comparison.*

There is no doubt left in my mind, that injuries heal quicker by Lister's treatment than I have seen them under any other.

Of the operations which I have seen performed and which were made with the observance of all details prescribed by him I mention Syme's amputation. The wound healed in this instance *per primam intentionem*, except the place where the drain-tube(!!) had been inserted, which produced but a few drops of pus. In ten days cicatrization was complete."

Further, extirpation of a fatty tumor in the neck, as large as a fist, and an athromacyte from the scalp, the wounds of both closed by first intention. Several large abscesses were opened and closed in a few days."

In an amputation at the knee-joint for extensive ulcerative disease of that "articulation, and in exsection of the elbow-joint, the antiseptic method could not be fully employed, but the suppuration was moderate and termination favorable.

I know very well that these results may be attained *by any other local treatment*, but I learned this to be the rule by the antiseptic method, which could not be said of other plans."

On one very important occasion Lister's method has clearly proven its superiority. The Glasgow Hospital is constructed in the best style of hygienic perfection. Notwithstanding, pyæmia, erysipelas and hospital gangrene occurred so often, and the mortality among the surgical cases was so alarmingly great, that it called for inquiry. At first the drainage was suspected of being defective, but this was soon recognized as an error, when a number of coffins were discovered not more than four feet below the floor of the basement of the hospital. It was then remembered that during the cholera epidemic of 1849 the present site of the hospital had served as a graveyard. There was still enough of the bodies left to cause that calamity among the surgical staff and their patients. About nine months prior to this occurrence Mr. Lister, then still at Glasgow, had introduced his antiseptic plan *which had kept his*

* Read to the Military Medical Society of Berlin, April 22d. 1872.

wards entirely free from these dangerous complications.

Sufficient is known of the practical utility of Lister's plan by this time, for us to concede its superiority over other modes of treatment of open wounds. But behind the plan stands in high relief, *the great surgical principle*, that *the repair of such wounds* is best advanced by hermetically shutting off the prejudicial effects of the atmosphere. When Lister has passed away and the carbolic acid has become forgotten, that principle will stand and assert its philosophical correctness.

Unfortunately I can adduce but meagre statistics of Lister's amputations, referring exclusively to a period of five years at Glasgow, viz: 35 amputations in the years 1864-'65, which were treated by the old plan of dressing. Of these, 16 died, or 45, 71-100 per cent. Next, in 1867, '68, '69, the same surgeon performed 40 amputations, with the assistance of his method, of which he lost but 6, or 15 per cent. These statistics show the marked reduction of mortality by 200 per cent. in favor of the antiseptic plan.

It seems that Lister has since, in addition to his own, adopted the Bordeaux plan, and of this we have no statistics to prove the superiority of the combination.

On theoretical grounds, I have already expressed adverse views with reference to Dr. Azam's method, but stubborn facts may eventually overcome my objections and determine me to withdraw them.

However this may be, so much is clear, that Burow's plan is infinitely superior in practical results, for he lost but 5 per cent. of his amputations, whilst it is at the same time simpler than Azam's or Lister's dressing, and therefore more practicable to surgeons in general.

From the following statement it will readily be seen, that, with little modification, Burow's plan has proven itself, in my hands, still more useful, and has given, by far, better statistical returns of

recoveries than any other, Burow's not excepted.

Like Burow, I invariably prefer the flap to the circular operation, even at localities where the latter seems unavoidable, as, for instance, in the neighborhood of the tibio-tarsal and brachio-carpal articulations; by trimming the flaps of all tendinous and bursal structures. The advantages are two-fold. In the first place, the flaps are left in their nutritive connection, are consequently better supplied with blood, and, therefore, do not slough so readily as do the integuments after circular amputations. Secondly, flaps are more readily adjusted and present a lesser wounded surface than that exhibited by the circular operation, simply because the segment of a cone is smaller than that of a cylinder of the same diameter.

Like Burow, I ligate all bleeding vessels, inclusive of veins.

Like Burow, I leave the wound exposed to the air as long as there is the slightest trace of sanguinolent oozing, or as long as the infiltration of the adjoining parts is signally relieved by the discharge of serum.

Like Burow, I unite the wound loosely by looped sutures so as to be able to tighten or slacken them whenever there is any cause for doing so, more especially when the swelling of the flaps requires relief.

Like Burow, I abstain from all interference with the flaps.

Unlike Burow, I discard adhesive strips, which he prefers to sutures in stumps of the upper extremities.

Unlike Burow, I exclude the air from having access to the wound by loosely encompassing the stump with a compress dipped in warm water, and with a piece of oiled silk. By this dressing the stump is continuously kept in a humid atmosphere of the same temperature, which, thus far, has proved itself most beneficial. This dressing admits of ready access for cleansing and redressing the stump.

Heretofore, I have employed silk for both

ligatures and sutures, with satisfactory results, but I do acknowledge the superiority of catgut for the one, and silver wire for the other.

This has been the simple plan by which I have treated, without exception, amputation stumps for the last eighteen years, and, I am pleased to say, with a success unprecedented in the surgery of the present century.

It has fallen to my lot to perform a comparatively large number of amputations for the removal of diseased joints and bones.

Most of the cases under my charge were aggravated by long suffering, reduced in strength and weight, and in not a few, pyæmia or septicæmia had supervened when I proceeded with the operation. Notwithstanding, my losses have been comparatively trifling.

In order, however, not to extend this communication beyond reasonable limits, I will restrict it to *the fifty-three amputations of the thigh* which I have made since adopting Burow's plan.

Of this number I lost the following seven cases from the causes specified:

CASE I.—Youth, aged eighteen years, badly nourished and anæmic; false ankylosis of the knee, with angular contracture. Admitted to St. John's hospital, Brooklyn. Divided hamstring muscles, subsequent forcible extension with a view of breaking up interarticular bands and adhesions. Contraction yielded readily without force. Unfortunately, instead of the interarticular connections the lower epiphysis had given way (diastasis) without being noticed by either myself or the rest of the surgical staff. Hence, slough of the textures of the popliteal space. Amputation in the middle of the thigh. The patient died from septic infection on the eleventh day.*

CASE II.—A laborer, aged thirty, received at the City Hospital, St. Louis, with a penetrating wound of the knee-joint of few days standing. Though of apparently fair constitution, the knee-joint suppurated copiously, and so reduced the patient in

weight and strength that amputation had to be resorted to. Died from septic infection.

CASE III.—A feeble tailor, aged thirty-five years, sustained fracture of lower third of femur. At a public hospital of Brooklyn, he was so carelessly treated, that the upper fragment overlapped the lower by six and one-half inches, and perforated the integuments at the inner aspect of and below the knee. Transferred to my charge at the Medical and Surgical Institute, I amputated thigh at its upper third. Was suffering from septic infection when operated on, and succumbed to this and phlebitis in a few days.

CASE IV.—Boy, aged five years, with compound and comminuted fracture of both bones of the leg, and symptoms of injuries to the nerves. Under conservative treatment did well for three weeks, when from some domestic irregularities, the neuralgia returned attended with muscular spasms, eventuating in trismus and tetanus. Had consultation, and was obliged to delay amputation forty-eight hours, against my remonstrance. Proved fatal. (Private.)

CASE V.—A girl, aged sixteen years, feeble and anæmic, with large bone abscess of lower third of femur, opening in the popliteal space. Amputation failed to preserve life. (Private.)

CASE VI.—A stout banker. Enchondroma of knee-joint. Amputation successful. Disease returned as encephaloid in the stump, lungs and heart. Death after six months.

CASE VII.—Gentleman of advanced age addicted to intemperance, rather broken constitution. Chronic synovitis of knee-joint; collection of sero-purulent effusion in the joint; contracture of biceps with angular position. Paracentesis of joint; removal of effusion; division of tendon bicipitis and extension. Left St. Luke's hospital for his home after six week's treatment apparently relieved.

Two months later was called to Lawrence, Kansas. Found patient greatly reduced, joint suppurating. Performed amputation; left patient three days later in charge of family attendant, doing very well. Died some time after, under circumstances not specially informed of.

Strictly speaking, cases No. IV and VI ought to be excluded. The fourth case died from causes entirely disconnected from either amputation or the treatment of the

* Compare Bauer's Lectures on Orthopædic Surgery, page 315, Wm. Wood & Co., New York.

stump. The sixth case, after having recovered from the operation, been for months up and about, died from extraneous causes. Even the seventh case leaves a doubt on my mind whether the amputation or the after-treatment, which was not under my control, caused his death.

The entire loss of my thigh amputations is thus reduced to five deaths, that is, less than ten per cent.

The remaining forty-seven cases recovered within an average time of twenty-eight days. Among the recoveries there were some cases which deserve special mention:

One case for injury of sciatic nerve (gun-shot wound) in a former soldier, which had given rise to:

1. An angular contraction of knee-joint.
2. A most intense neuralgia coupled with paresis.
3. To an extensive squamous disease of the integuments below the injury (Ichthyosis with degeneration of toe-nails).

Division of contracted muscles brought no relief. Yielded to the demand of patient for amputation in the upper third. (Private.)

One case of somewhat similar character in a lady, aged thirty-one years. Originally rheumatic synovitis, terminating in inter-articular adhesion of knee-joint and contraction of flexors of leg. An attempt had been made at *brisement forcé* (Louisville) without tenotomy and anaesthesia (relata-refero). The result was most deplorable. Violent neuralgia in the affected member (probably from neuroma) which yielded but to amputation in the middle of thigh. (Private.)

One case of laceration of the knee-joint in a middle-aged German grocer (Brooklyn) caused by runaway accident. Found the wound closed by sutures; knee-joint excessively swollen, painful and suppurating. Removed suture, cleansed the wound from dirt and a little pebble stone left inside the articulation. Symptoms of advanced typhoid septicæmia prevailed. Had con-

nosis pessima. Counsel, Dr. Dan. Ayres, objected to operation for cogent reasons. I prevailed, since the general condition was caused by the local trouble, and the possibility could not be denied, that the removal of the cause might remove its effect upon the constitution also. Amputation performed at the middle of the thigh, whilst patient was unconscious and delirious. Recovery.

One case of boy eleven years old. Compound, comminuted fracture of bones of leg, crushed between the pier and ferryboat, Brooklyn. Amputation at the knee-joint by the late Prof. Enos. Osteomyelitis of exposed epiphysis, great suffering and suppuration. Six weeks after first amputation, I made the second operation in the middle of thigh. Recovery in ten days. (Private.)

Nine cases for more or less extensive and advanced osteomyelitis compromising, in three cases, the articulation of the knee. All recovered within twenty-one days.

Two cases of bony ankylosis of knee-joint and angular distortion. The one afflicted with caries of the tibia, nothing short of amputation could reach his case. Recovery in eighteen days. The other, a youth of nineteen years. Originally periostitis and subsequent sequestration of part of tibia. Resection of bone and recovery from previous operation. But the growth of the bone became arrested. When I saw the patient (at Rock Island) in consultation with the talented and expert Dr. Truesdale, I found the limb exactly six inches shorter than its well-developed fellow-member. Resection of the ankylosed joint would have shortened the extremity still more and impeded its use, irrespective to the disfigurement. I therefore suggested amputation, which the ambitious patient was but too glad to accept. The posterior flaps had to be taken from the calf and answered admirably. Although the operation was performed by Dr. Truesdale, whom I gladly

stump was employed which I invariably follow. The result was quite satisfactory.

One case of perforating wound of the knee-joint from the removal of a bullet, in a healthy police officer. The attending surgeon had performed the operation at his office and then allowed the patient to walk home! The consequences may as well be imagined as described. When I took charge, the case was fully ripe for amputation, which was accordingly performed. Recovery in twenty-six days. (St. Luke's hospital.)

One case of thrombosis of the femoral artery with its dependant branches, in an old soldier, fifty-six years of age, eventuating in mummification of the foot. The direct cause had probably been arteritis from exposure to intense cold, while in the service of the United States. The amputation had to be made immediately below the origin of the femoralis profunda, and even there the main trunk of the artery was found to be obstructed and but two ligatures in all had to be applied. With the exception of an abscess which formed in the fleshy part of the stump, the patient had a safe, although slow recovery—forty-two days. (St. Luke's hospital.)

Eleven cases of miscellaneous injuries of the leg and knee-joint.

Eighteen cases for pathological disorganization of the knee-joint and adjacent structures.

Comments seem to be unnecessary, for figures speak for themselves. This extraordinary result of my amputations would be still better, if I had included the minor operations of this kind. Thus I might opportunely mention that I, but a few months ago had an amputation of the leg, at St. Luke's hospital, of a farmer from Illinois, who had his tibio-tarsal articulation lacerated, which had been suppurating for several months, and reduced the patient to a skeleton, while he exhibited signs of pyæmia. I had to defer the amputation

tremity. He left for his home in seventeen days, the wound being almost entirely cicatrized.

Further, a railroad accident to a child but two years old, almost severed and fearfully lacerated both the right leg and arm. The child was nigh bloodless when I operated, and the wounds were still oozing. Recovery was perfect in sixteen days. On this occasion the attending physician urged the use of carbolic acid, but I declined it, trusting to the disinfecting properties of warm water and cleanliness.

I raise no claim to any superior skill over and above my surgical brethren; I believe, furthermore, that in as much as my patients were mostly in private practice, that this fact had some influence in lessening my losses, but I must, therefore, with Burow, come to the same conclusion, that the after-treatment of stumps had something to do with my extraordinary success, which exceeds even that of Burow by 100 per cent., who lost, of fifteen thigh amputations, three, that is, 20 per cent., while my losses did not even quite reach 10 per cent.

The only merit which I may justly claim in the premises, is the incessant attention which I have paid to my patients, so that not a drop of matter could have escaped my vigilance, and that I have steadily borne in mind the fundamental principle of surgery, *ubi pus ibi evacua!*

The statistics derived from amputations of a former period, are much more unfavorable when compared with the present, as the following notes indicate:

110 miscellaneous amputations at the University hospital of Dorpat, collected by Prof. Szymonowski from a certain period furnished, 22.023 per cent. of deaths.

300 larger amputations collected from the case book of St. George's hospital, London, by Mr. T. Holmes, resulted in eighty-three deaths, or 27 per cent.

7,678 amputations, collected by Prof. Pauli from miscellaneous sources, with a

5,851 amputations tabulated by Mr. Jas. R. Lane, taken from military and civil, private and hospital practice with a mortality of 28 per cent.

6,264 amputations analyzed by Sir James Y. Simpson with 28 per cent. loss.

As a matter of course, statistics derived from miscellaneous sources must always be taken with due allowance as regards the conditions and surroundings under which the patients were placed. But if a liberal deduction is made, a high percentage of mortality still remains. Including all the minor amputations, the anterior parts of the hand and the foot, the lower part of the arm and leg, even 20 per cent. would be fearful mortuary statistics. In as much as the losses occur principally in the larger amputations, as, for example, of the thigh and upper arm, we may readily conceive how dangerous these operations have been in the past.

In our country the very same statistical returns are recorded in the diligent and elaborate article by Dr. James A. Chadwick. His material, 1770 amputations, has been derived from the best institutions in the United States, viz: from the Pennsylvania, New York City, Massachusetts, and Boston City hospitals, yet 384 deaths, or 28 per cent. are recorded.

Compared with the more recent results attained by Profs. Burow, Lister and myself, it is evident that the changed and improved treatment of stumps has exercised its due influence upon the statistical returns.

The question naturally arises as to the comparative superiority of the one or other of these dressings.

The Bordeaux method does not commend itself by either striking results or by its technical perfection.

If Lister's antiseptic method has furnished better statistical returns, they are due, however, not so much to the drainage tube and deep suture, nor to the carbolic acid, but to lighter and commodious covering of stumps and the interposition of oiled silk and mackintosh against the action of the atmospheric air. This opinion is sustained by the fact referred to in the paper of Dr. Schulze, that Lister performed some most dangerous operations upon the knee and elbow joints for advanced pathological disintegration of said joints, with already established sepsis of the secretions. Yet,

withstanding that the antiseptic treatment could not be fully employed. And the further fact, that thousands of amputations have been successful without Lister's antiseptic panacea having been used. In fine, the fact, that some surgeons leave the amputation wound fully exposed to the action of air and have thereby fair recoveries, seems conclusively to prove that the bacteriae are, after all, not such dangerous monsters as Lister and his disciples would lead us to believe.

Moreover, if we allow ourselves to be guided exclusively by statistics, Lister's achievements by the antiseptic method are not so alluring either. For Lister lost, from forty amputations, fifteen per cent., whilst Burow lost from sixty-two amputations but five per cent. Obviously, Burow's results are two hundred per cent. better, whilst they were achieved by so simple a plan that every country practitioner can readily follow it.

The plan which I have followed during the last eighteen years, is essentially derived from Burow's suggestions, and the success I have had in my amputations is virtually attributable to the sound reasoning and practice of that surgeon. Possibly the additions I have made to his plan may have been so material as to effect the beneficial results I have achieved.

It will be observed that I keep the wound continually in a moist atmosphere of the temperature of the body, and, besides, protect it from the action of the air by a piece of oiled silk. Thus far, this dressing has given me full satisfaction and returns that speak for themselves. Ten or even thirteen per cent. of deaths from thigh amputations, compare most favorably with the statistics of that operation of any other surgeon known in the annals of surgery. And not before Lister can show a better table of recoveries shall I prefer his antiseptic method to that of Burow and myself.

I need not to state that I have adopted the same method in the treatment of other wounds, caused either by accident or by operations, that I invariably employ it in resections of joints and bones, and that the results have been as favorable as in amputations.

At any rate the ball is in motion and is not likely to come to a stand-still until the important question of the rational treatment of stumps shall be finally settled.

